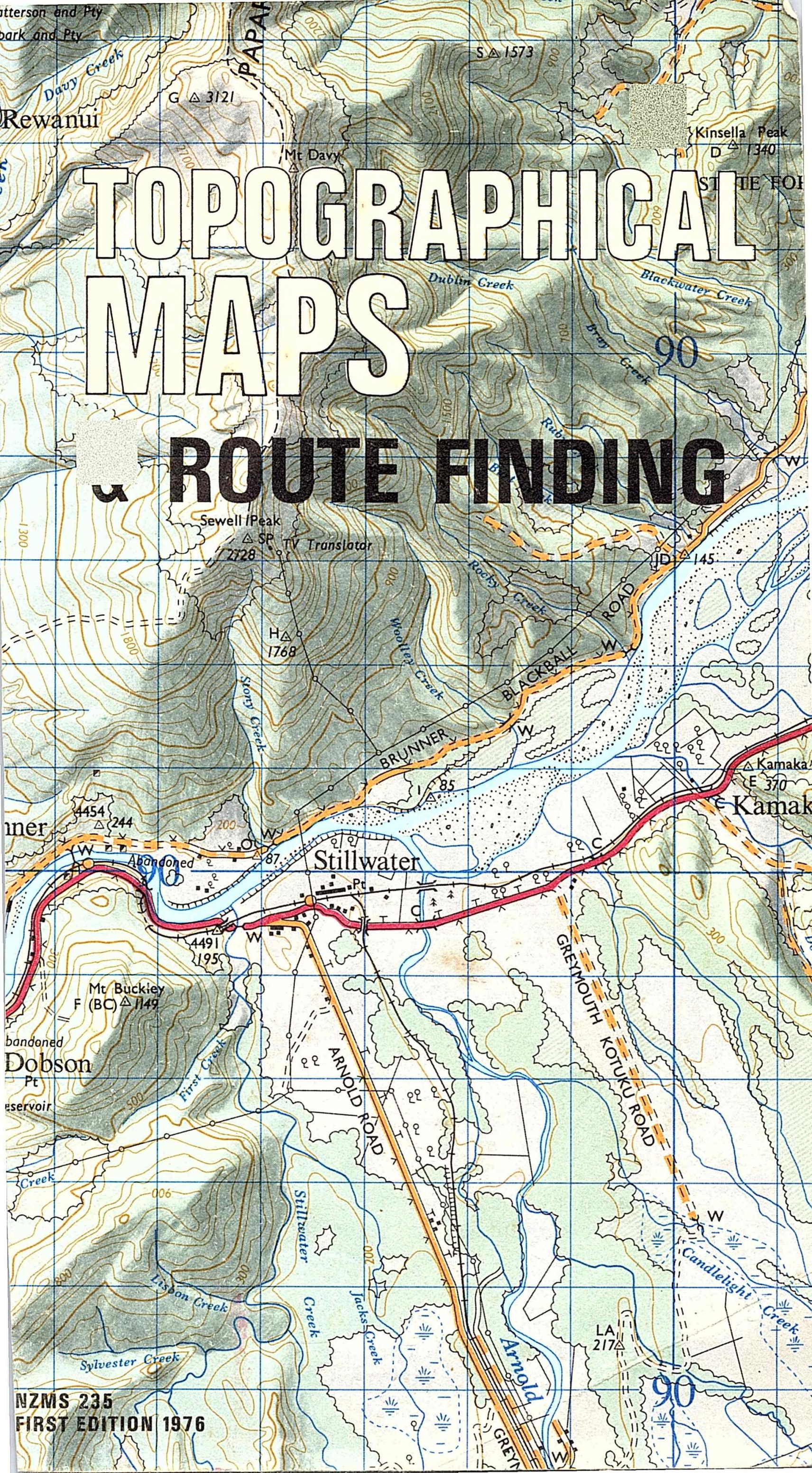
TOPOGRAPHICAL MAPS

ROUTE FINDING



PREFACE

This booklet has been compiled to provide a basic understanding of topographical maps and their use as an aid to route finding in the back country of New Zealand.

In territory where terrain or climatic conditions constitute risks to safety the loss of route by a traveller may mean inconvenience or even endanger life. Knowledge of the use of map and compass to assist in route finding will greatly reduce such risks.

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Compiled with the assistance of the New Zealand Mountain Safety Council and the Tourist and Publicity Department.

Paul H. Denys 1-00

Topographical Maps

Maps have been used since ancient times as a means of indicating pictorially the relative positions of features of the Earth's surface.

Today, maps are able to fulfil any of a multitude of requirements depending on the type of features depicted.

Maps may be used as an aid to detailed planning and development of any area of land from residential sections to entire countries. This is planning for the future, and involves engineers, town planners, surveyors, architects and many other specialists making intelligent and efficient use of natural resources and features to the greatest benefit of all.

However, many map users are more vitally concerned with deriving information that will assist them to find their way about an area with a foreknowledge of the terrain and obstacles that may lie in their path. Topographical maps are ideal for this purpose, showing the Earth's natural physical and cultural, or 'man-made' features in such a way that close study of the map can give the user a detailed 'picture' of the area represented.

NEW ZEALAND TOPOGRAPHICAL MAP SERIES

NZMS 1

The primary series produced by the Department of Lands and Survey is the NZMS 1 Topographical Map Series 1 : 63,360 (one inch to one mile). New Zealand except for Stewart Island, is covered by 316 published sheets.

NZMS 18

Another series of complete topographic coverage is NZMS 18 Topographical Map Series 1 : 250,000 (one inch to approximately four miles), which consists of 26 published sheets.

OTHER SERIES

There are many other useful maps showing topographic information, but perhaps the National Park series is worthy of special mention.

The ten National Parks are covered by this series at scales determined by the Park size. Thus the largest, Fiordland, has a scale of 1 : 300,000 and the smallest, Abel Tasman, is at 1 : 40,000.

An index showing NZMS 1 and NZMS 18 sheetlines is shown on the inside back cover.

Full details of these and other maps available are contained in the free Map Brochure (NZMS 197/1) published by the Department of Lands and Survey.

MAP COMPILATION

Methods of collecting the information required to make up a topographical map have changed considerably since the time when details were sketched by hand in the field. Today, most topographical maps are compiled in the office by photogrammetric methods, using aerial photographs and stereoscopic plotting instruments. These complex instruments are able to project images from two overlapping aerial photographs in such a way that a three dimensional picture is obtained of the terrain. From this the photogrammetrist is able to accurately trace on to a compilation plot all the contours, streams, roads and other required details, tying this information into a framework of control points previously established by surveyors. This compilation plot is then subjected to a field check to obtain information such as street names and road surface classification, which cannot be determined from the aerial photographs. Finally, the corrected plot goes to the cartographers who prepare final drawings ready for the printer.

MAP BORDER INFORMATION

All map users should be familiar with the information available in written and pictorial form around the edges of the map. This data identifies and explains the map, giving details not only for use in connection with the map itself but also the date of the information and the sources from which it has been compiled.

There are notes regarding the amount of magnetic declination in the area covered by the map, instructions on how to give a grid reference, an index to adjoining sheets, a linear scale and a sample of all the conventional symbols which may be used on the map.

GRIDS & MAP REFERENCES

Topographical maps are provided with a system of squares, called a grid, so that positions on the map may be described numerically. These grid lines do not correspond to lines of longitude and latitude nor are they quite parallel to them. (The map 'graticule' showing divisions of latitude and longitude is represented by divisions around the edge of the map, but need not be referred to for normal purposes of describing locations or for route finding).

The grids are represented on NZMS 1 maps by squares of 1000 yds, on NZMS 18 maps by squares of 10,000 yds and on other topographic maps by squares suited to the scale of the map.

Full grid values are given at the corners of each map and abbreviated values label each grid line at the edges. The grid squares can be divided into tenths giving an accuracy of reference to as close as 100 yds on NZMS 1 maps.

To give a grid reference always state the:

East value first (figures along the top and bottom of the map).

Then the North value (figures at the sides of the map).

Example:

From the NZMS 1 map extract below, the grid reference for—

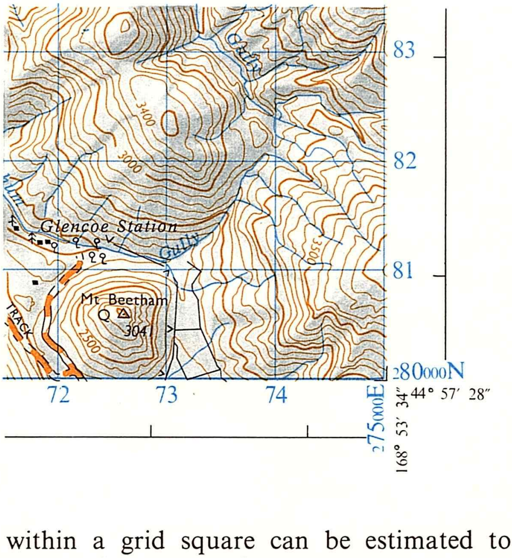
Mt Beetham, is:

$72\frac{6}{10}$ East—726
$80\frac{6}{10}$ North—806

Therefore, the GR is <u>726806</u>

When quoting a six-figure grid reference a description of the feature, and the sheet number should also be given viz.

Mt. Beetham—S123/726806



(Positions within a grid square can be estimated to tenths, i.e. 100 yards, on NZMS 1 maps.)

MAP SCALE

Ground features are shown on a map in the same relative position as their actual location, but symbolically reduced to a fraction of their true size. The amount of reduction applied is known as the Representative Fraction (RF).

The RF is usually expressed on the map as a ratio.

eg. 1 : 63,360

The numerator, usually 1, represents map distance and the denominator, a large number, represents ground distance. Thus, 1 unit on the map represents 63,360 units on the ground. Therefore the ratio scale 1 : 63,360 may also be stated as:—

1″ = 63,360″
or 1 cm = 63,360 cm
or 1 ft = 63,360 ft

In this instance, as there are 63,360 inches in one mile, the scale may also, more conveniently, be stated as:—

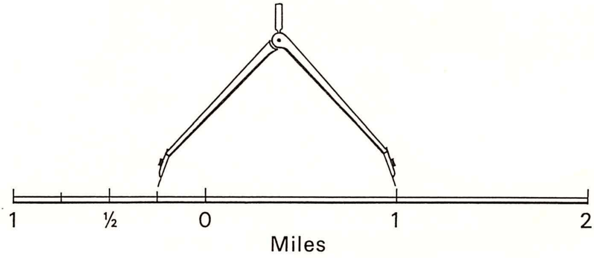
'one inch to one mile'

The map portions opposite will give an idea of the size of areas covered by maps of the two main series of topographical maps produced by the Department of Lands and Survey.

In addition to a written scale, or RF, a linear scale is shown.

The smaller divisions to the left of the zero are for measuring fractions.

In the example below the length of the measurement is one and a quarter miles.



NZMS 1

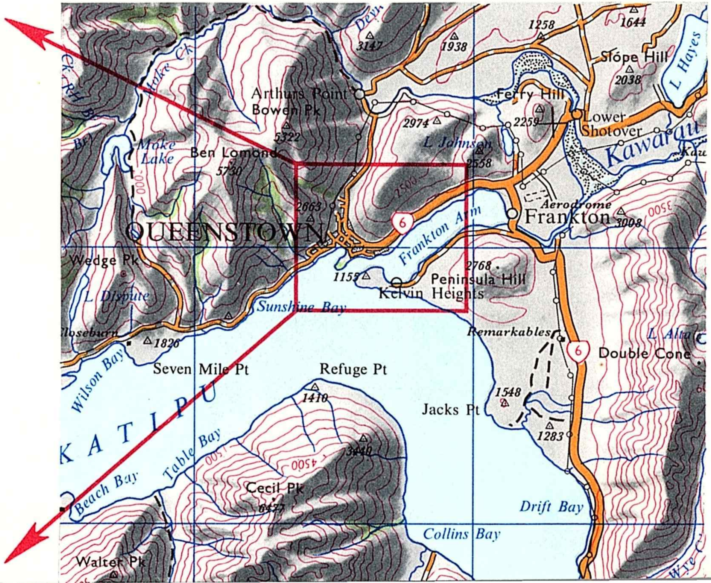
1 : 63,360
(1″ to 1 mile)

Area shown – 10 square miles

NZMS 18

1 : 250,000
(1″ to approx 4 miles)

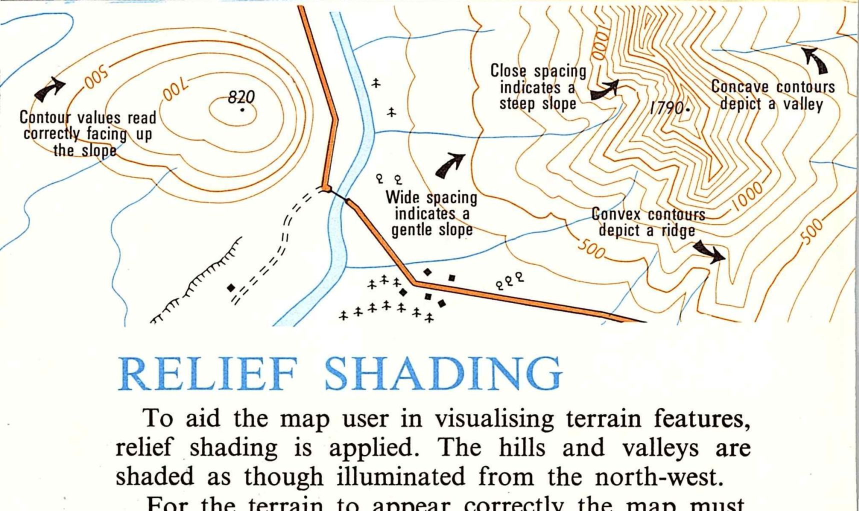
Area shown–160 square miles



CONTOURS

Contour lines are drawn through points of the ground having the same height above Mean Sea Level. The vertical distance between adjacent contour lines is called the Vertical Interval (V.I.), and varies according to map scale.

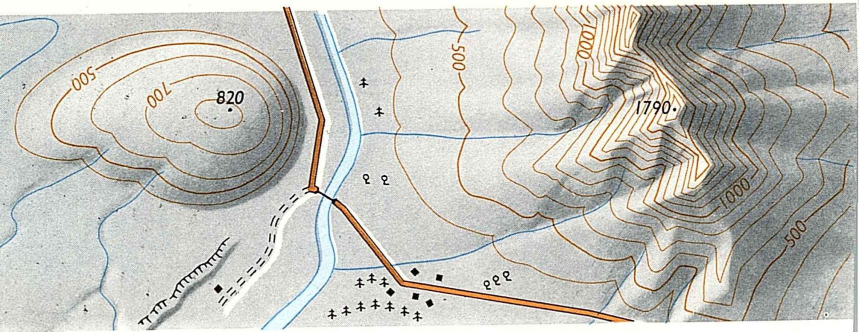
On NZMS 1 maps the V.I. is 100 ft
On NZMS 18 maps the V.I. is 500 ft



RELIEF SHADING

To aid the map user in visualising terrain features, relief shading is applied. The hills and valleys are shaded as though illuminated from the north-west.

For the terrain to appear correctly the map must be viewed from the bottom, as a reverse effect is given if the map is viewed upside down.



MAP INTERPRETATION

Map interpretation is the art of extracting from a map all the information it contains so that a 'picture' can be drawn in the mind of the shapes and slopes of the ground, the pattern of streams and rivers, the vegetation cover and the location and nature of man-made features.

Map reading is best learnt through experience, out of doors, by comparing the symbolised detail on the map with the actual area of country it portrays. However, much can also be learnt at home by studying a map of a well known piece of country—then, once an appreciation of the map and its symbols has been acquired by comparison with known terrain, this knowledge can be used in reverse to gain an appreciation of unknown terrain from the map. For example, by comparing the spacing of contour lines in a known area to those in an unknown area, the relative steepness of a slope may be determined.

The illustrations opposite show how the third dimension may be depicted on a map. Although relief shading assists visualisation, contours are still necessary to provide value to the elevations represented.

Due to the limitations of scale it is not possible to show all the features which exist on the ground, and recognition of these limitations is important in map reading. If the shape of the contour lines indicates a small valley it is likely that a watercourse may exist. However, because of its relatively small size this feature may not be shown on the map.

The degree of accuracy of the map will be indicated from the method by which it was compiled. A map compiled from aerial photography by stereo plotting instrument could be expected to be more accurate than one based on planetable surveys. The reliability diagram in the margin provides this information, together with dates of photography and field checking.

6

MAP SYMBOLS

Symbols are used on maps to represent features which exist on the ground. In many cases these features are easily recognised—buildings, streams, trees and roads for example.

Other symbols, however, represent intangible features. Contour lines, for example, will not be seen lying on the ground although they are one of the most important and useful symbols on the map.

Thus, whether tangible or not, the collection of symbols which make up a map are chosen because, in the opinion of the cartographer, they add usefully to the information shown on the map, and are designed so that they are readily identifiable with the feature they represent. Indeed, on a well designed map it should hardly be necessary to consult the reference panel at all.

The use of colour is an additional aid to identification. Generally, blue for hydrography, black for culture (man-made), and green for vegetation are internationally standard. Other colours are then selected to show as clearly as possible any further information such as relief, road classification, etc. so that the overall effect is a pleasing and, more importantly, legible combination of colour, symbols and type.

Roads

- Three lanes or more wide
- Sealed
- Metalled
- Unmetalled
- Unfenced
- Tracks:
  - Vehicle
  - Foot
- State Highways:
  - National — 2 — metalled, sealed
  - Provincial — 39 — metalled, sealed

Railways

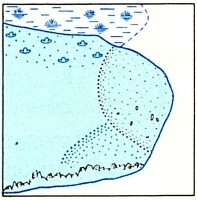
- Double or multiple track
- Single track
- Road over railway
- Railway over road
- Level crossing
- Station
- Tunnel
- Cutting
- Embankment
- Footbridge — f
- Bush tramway

Electric Power Lines

- Transmission lines: (over 11,000 volts)
  - Pylons; actual positions
  - Poles; conventional spacing
- Distribution lines:
  - (11,000 volts and under)

Hydrography

- Drain
- Drain beside fence
- Water race — WR
- Stream or watercourse
- Indefinite stream
- Dam; Waterfall
- Cold spring; Hot spring
- Swamp
- Mangroves
- Sand
- Shingle
- Sand & Mud
- Rocks



Vegetation

- Bush
- Plantation
- Orchard
- Scrub
- Burnt or fallen bush
- Trees

Miscellaneous

- Trig station
- Bench mark
- Elevation in feet — ·765
- Post and Telegraph Office — Pt
- Post Office only — P
- Telephone only — t
- Telephone line
- Saddle
- Sandhills
- Rock outcrop
- Cliff or terrace
- Slip
- Cave
- Fence or hedge
- Stopbank
- Built up area
- Church
- Building
- Homestead — *Dalgarth*
- Cemetery
- Radio masts
- Historical maori pa
- Windpump
- Beacon
- Lighthouse
- Mine; underground
- Mine; opencast
- Gravel pit
- Quarry
- Pipeline — PL
- National Park Boundary
- Wilderness Area boundary

Bridges

- Two lanes
- One lane
- Concrete — C
- Wooden — W
- Steel — St
- Suspension — S
- Footbridge — f
- Ford — F

Contours

- Index — 500
- Intermediate — 400
- Supplementary — 350
- Depression — 800, 700

MAP REVISION

It will be appreciated that while natural features remain relatively undisturbed, cultural features are subject to constant change, and therefore the information on a map must be constantly revised.

Maps showing such a wealth of information as that on the NZMS 1 series would need to be revised continuously in order to keep them completely up to date but with a large number of maps to produce this is not possible.

The rate and amount of change varies greatly from urban to remote areas and therefore maps are not all revised at definite intervals or to the same extent.

The needs of the map users for up-to-date maps are considered in selecting maps for revision.

Revision methods vary, but are usually a combination of photogrammetric, field and cartographic procedures designed to up-date the information shown and to maintain or improve the original accuracy of the map.

Map users can assist by providing information on apparent errors or omissions to the Department of Lands and Survey.

Correspondence, which will be acknowledged, should be addressed to:—

The Surveyor-General
Department of Lands and Survey
Private Bag
Wellington

METRICATION

Eventually all maps produced by the Department of Lands and Survey will be in metric terms.

On some maps this may amount to no more than showing scale values in metres and kilometres instead of yards and miles, but for many other maps the opportunity is being taken to completely redesign layout, content and symbolisation.

The following is a brief description of the new series of metric maps which will replace those referred to in this booklet.

NZMS 260 N.Z. TOPOGRAPHICAL MAP 1 : 50 000

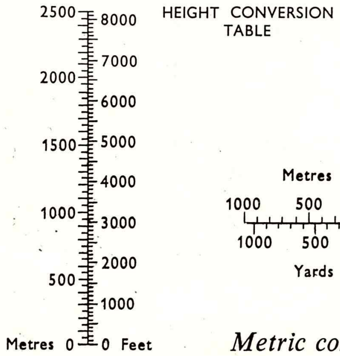
This series will be the main topographical series and will supersede the present NZMS 1 1 : 63,360 series.

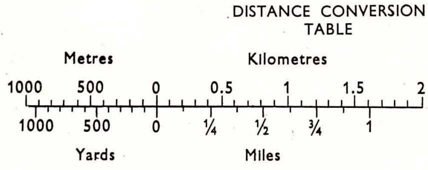
Information shown will be basically as for NZMS 1 with some additional features and improved symbolisation. Among the main changes will be depiction of the metric New Zealand Map Grid, contours at 20 metre vertical intervals and the extension of map detail to the edge of the paper at the top and right hand sides.

The sheet numbering system will be by letters A-Z from west to east, and by numbers 01-50 from north to south. Each sheet is also named, e.g. R27 Wellington.

NZMS 262 N.Z. TOPOGRAPHICAL MAP 1 : 250 000

This series will supersede the present NZMS 18 1 : 250,000 series. Although the scale is unchanged the new series will incorporate several improvements in design.



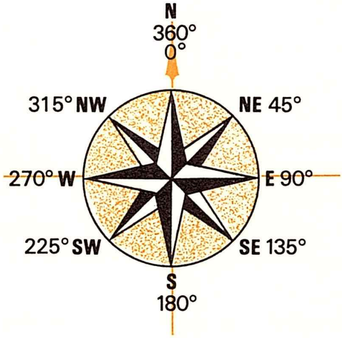


Metric conversion tables

Direction Finding

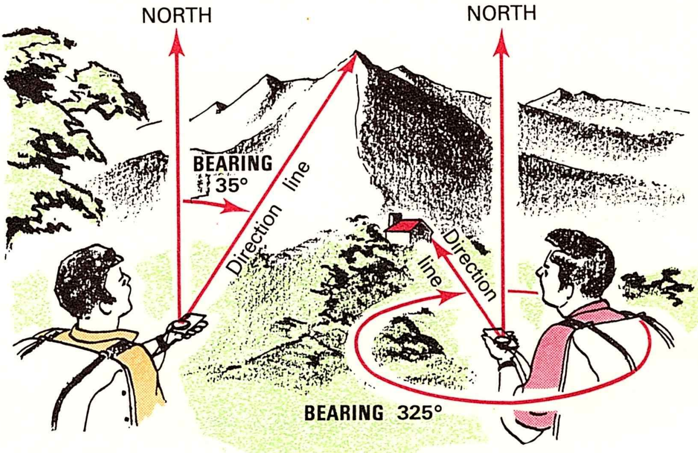
POINTS OF THE COMPASS

A basic method of describing direction is by referring to the cardinal and inter-cardinal points of the compass i.e. North, East, South, West, North-East, South-East, South-West, North-West.



BEARINGS

A bearing is the horizontal angle measured in degrees *clockwise* from North to a direction line. By measuring angular bearings in degrees a direction may be defined more precisely than by stating the nearest cardinal or inter-cardinal point.



TRUE NORTH: GRID NORTH: MAGNETIC NORTH

TRUE NORTH is the direction towards the Earth's geographic North Pole.

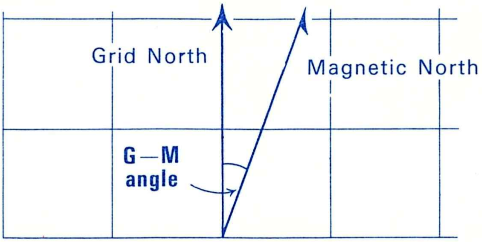
GRID NORTH is the direction of all the vertical grid lines on a topographical map.

Grid North (and not True North) is normally used as the reference direction for the measurement of bearings (i.e. Grid bearings) on a map.

(The angular difference between Grid North and True North varies across the country but on New Zealand topographic maps it is always less than 4°).

MAGNETIC NORTH is the direction in which the magnetic compass needle points, i.e. towards the north magnetic pole in northern Canada. In New Zealand the direction of Magnetic North is approximately 20° East of True North and Grid North.

The map border information will include the actual Grid-Magnetic (G-M) angle for the area covered by the map. The change in the G-M angle over the years (caused by the slight movement of the north magnetic pole) is also shown, but this is insignificant for route finding purposes and can be ignored.



THE MAGNETIC COMPASS

The magnetic compass is an important aid to route finding and one should be carried by any venturer into untracked country.

Magnetic compasses work on the principle that the pivoting magnetised needle, or the north point of the swinging dial always points to the north magnetic pole. Thus, a compass with graduations (degrees) marked on it can be used to measure the bearing of a direction line from Magnetic North.

TYPES OF COMPASS

Several types of compass, of varying quality and utility are available.

The simplest type has a magnetised needle swinging on a pivot with a fixed, graduated dial on the base of the compass.

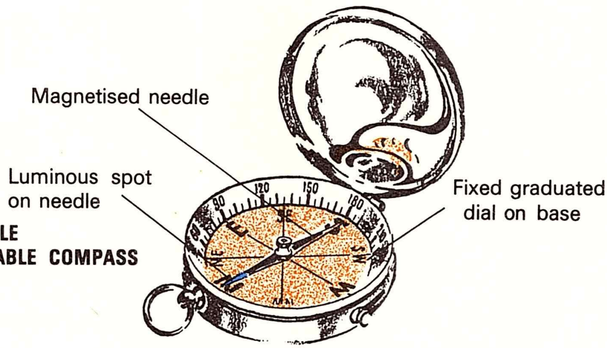
This type is not usually 'damped', that is it does not have the facility to steady the excessive swinging of the needle to bring it quickly to rest.

Another general category of compass is the swinging dial type which is magnetised so that the zero, or north point, of the swinging graduated dial points to Magnetic North. The prismatic and semi-prismatic compasses are of this type. Although prismatic compasses are accurate and useful for making sketch maps, they are expensive and are not ideally suited to route-finding.

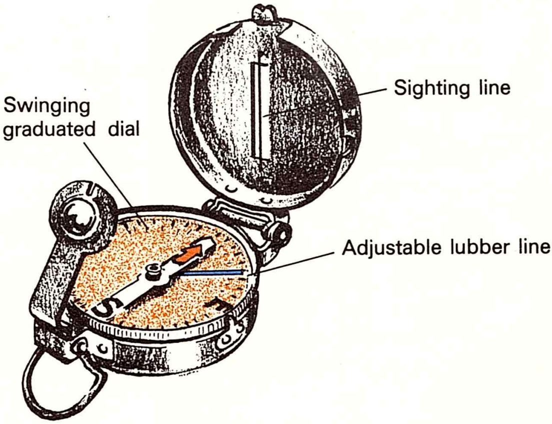
One of the more useful types of compass is the pivoted needle, adjustable dial type, in which the graduated circular dial can be twisted around relative to the base of the compass. One such model is the Silva, Type 3, illustrated opposite.

In addition to the main attributes of pivoted needle and adjustable dial the Silva model has a transparent base, and orienting lines marked on the adjustable dial housing so that it can be used as a protractor for measuring grid bearings on the map.

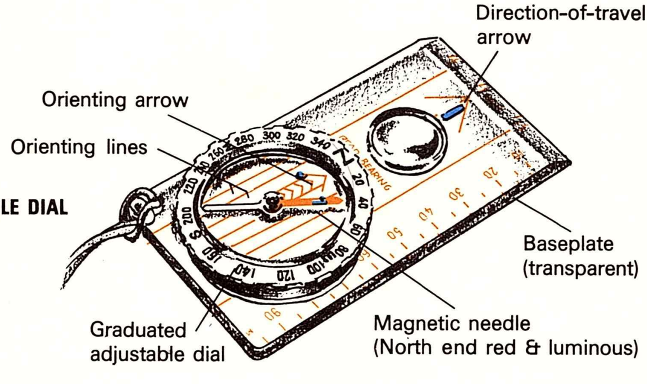
PIVOTED NEEDLE NON-ADJUSTABLE COMPASS



SWINGING DIAL COMPASS



ADJUSTABLE DIAL COMPASS



USE OF THE COMPASS

Whatever type of compass is selected it is important to become proficient in its use.

It is recommended that the novice become thoroughly proficient in the simple uses of map and compass before attempting to use the more advanced methods. Regular practice is the best way to gain ability and confidence so that mistakes are less likely to be made under pressure (which is when they can least afford to be made).

Besides the techniques described in this booklet there are a number of alternative methods of compass use which may be employed. However, to avoid confusion the novice should concentrate on using only one set of techniques.

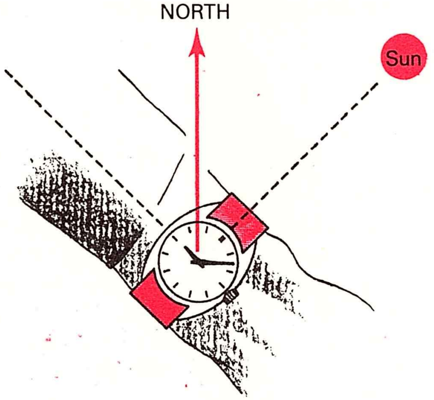
It is important to be certain which end of the compass needle is the North end. On most types the North end is painted and/or has a luminous tip. However, some compasses can become reverse magnetised if stored with the needle clamped for a long period near a strongly magnetic object, such as an exposure meter or radio set, and should be checked before setting out.

When the compass is being read it must be well clear of iron objects which could deflect the needle. These include steel pack frames, sheath knives, axes, rifles and iron huts. The heavier the iron, the more distant the compass should be during use—a metre or so from an axe, 10 or 20 metres from a hut.

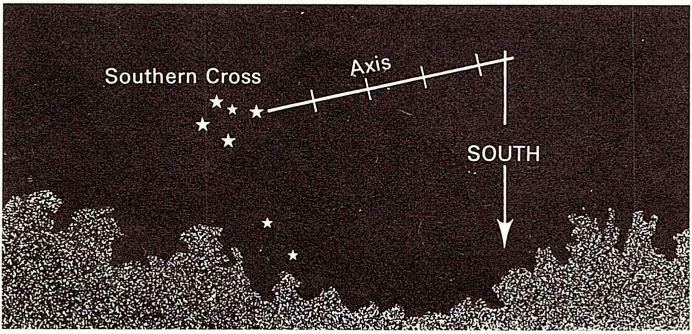
DIRECTION FINDING WITHOUT A COMPASS OR MAP

If a compass is not available the sun or stars may be used to determine direction. The following rules apply in New Zealand.

If the sun is visible, point the figure 12 on a watch towards the sun, then true north is approximately half way between the 12 and the hour hand. (If uncertain of this rule, picture yourself using this method at home, at 9 o'clock in the morning.)



If the stars are visible, extend the long axis of the Southern Cross from its tail by $4\frac{1}{2}$ times its length; this point is almost directly above true south.



Route Finding

The following section describes methods of using map and compass for route finding. It is important to realise that successful route finding in rough country requires the development of a number of personal attributes as well as the proper use of map and compass. One needs to develop keen powers of observation and memory and a knowledge of how various landforms, streams and vegetation can help or hinder in affording a route through the country.

For further information on these aspects refer to the National Mountain Safety Council Manual "Bushcraft".

PRIOR USE OF THE MAP

Before setting out, the map should be studied to help select a suitable route and to help visualise features to be encountered en route.

In addition to showing which routes have established tracks and bridges, the topographical map can help the intending traveller to select a leading spur or main ridge to travel on; to avoid river valleys marked with gorges or steep sidling country indicated by closely spaced contours; to measure the distance to travel or height to climb and so estimate approximately how long each stage may take; to assess the probable size of a river from the extent of its catchment area upstream; and generally to make the best use of features of the country when planning the route.

Prior study of the map to visualise and anticipate features will reduce the chances of failing later to recognise important places such as branching of the track, or forks of a stream, and possibly save hours of time wasted through overshooting a salient landmark.

EN ROUTE

When travelling, the map and compass should be carried in a handy place so that either can be referred to easily and frequently. In wet weather a clear plastic bag can be used to protect the map, which can be folded with the appropriate area showing outermost.

SIMPLE USES OF MAP & COMPASS

In many cases, route finding methods of great accuracy are not required. Also, particularly for novices, the most important need is to avoid confusion so that confidence is gained before more complex methods are employed. This section describes basic methods of using an oriented map and magnetic bearings which may be applied with any type of compass.

ORIENTING A MAP

A map is said to be 'oriented' when it is placed so that directions on it correspond to the directions to the same features on the ground. This may be done by holding the map horizontally so that identifiable features lie in the same direction on the map and ground.

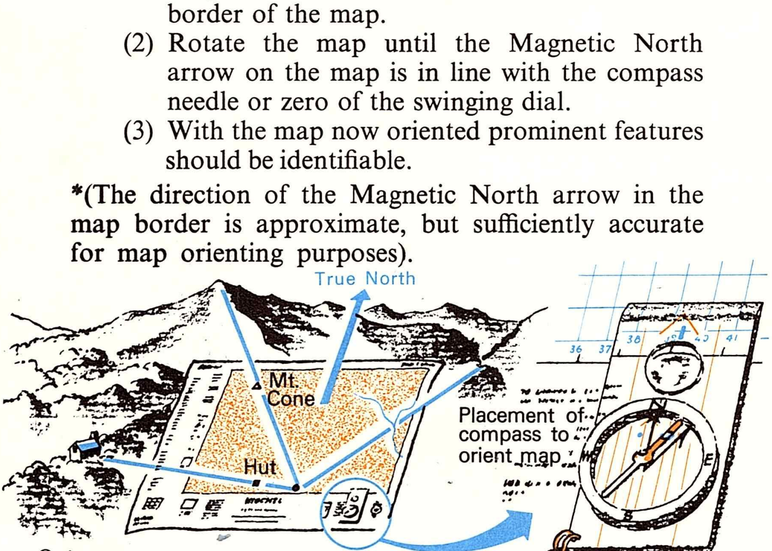
However, if none of the surrounding features can be identified the following method, using a compass, is suggested.

(1) Lie the map flat and place the compass over the Magnetic North* arrow line shown in the border of the map.

(2) Rotate the map until the Magnetic North arrow on the map is in line with the compass needle or zero of the swinging dial.

(3) With the map now oriented prominent features should be identifiable.

***(The direction of the Magnetic North arrow in the map border is approximate, but sufficiently accurate for map orienting purposes).**

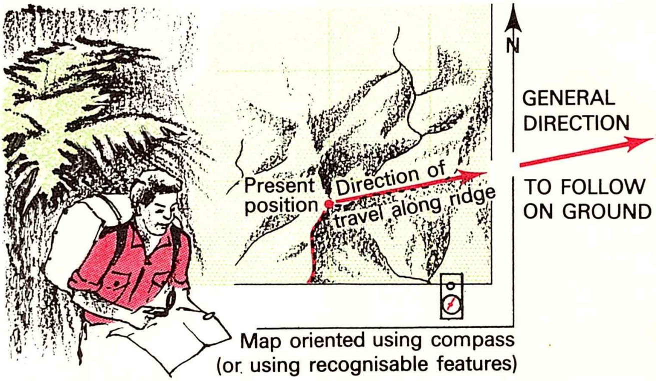


Orienting a map

Orienting the map is a necessary step for some of the procedures described in this booklet. In any case it is worth developing the habit of orienting the map (even if only approximately) whenever it is being read.

FINDING DIRECTION OF TRAVEL FROM THE MAP

To decide in which direction to travel when the objective cannot be seen the map should first be oriented. Then by sighting or laying a straight line (perhaps a length of thin string) across the map over the next stage of the route the general direction to follow is defined.



Finding direction of travel

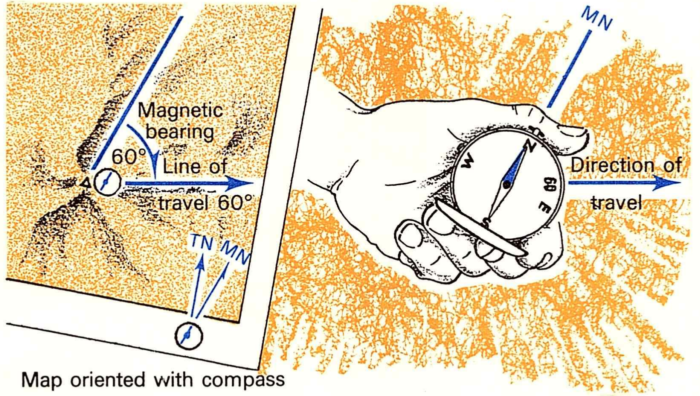
FOLLOWING A COURSE WITH A COMPASS

To set a magnetic compass bearing on a desired direction of travel indicated from the map, and to subsequently check that the course is being followed, one of these methods (depending on the type of compass) may be used.

(a) USING A NON-ADJUSTABLE COMPASS

1. Orient the map, using the compass.
2. Place the compass on the map with the compass centre on the line of travel and rotate the compass until the N point of the base is under the needle point.
3. Sight across the compass (or stretch a length of string) along the general line of travel shown on the map then read the magnetic bearing on the destination side of the compass.
4. Memorise the magnetic bearing before moving on in that direction.
5. To check the course occasionally during travel hold the compass horizontal and steady and turn it until the N point of the base is under the needle point.

   Desired direction is in line with the memorised magnetic bearing.

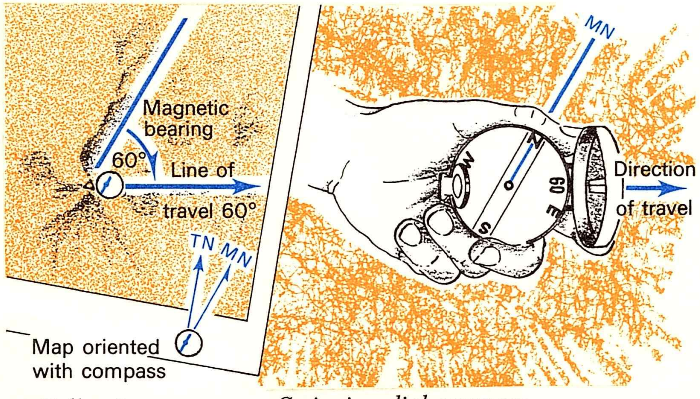


Following a course – Non-adjustable compass

(b) USING A SWINGING DIAL COMPASS

1. Orient the map, using the compass.
2. Place the compass on the map with the sighting line aligned along the next stage of the route.
3. Read the magnetic bearing from the compass dial in the direction of travel at the sighting line.
4. Memorise the magnetic bearing before moving on. (Alternatively, if the compass has an adjustable lubber line, rotate the lubber line until it is over the N point of the swinging dial; this will save having to memorise the bearing).
5. To check the course during travel, hold the compass steady and turn it until the sighting line is at the memorised bearing. (Alternatively, if the lubber line has been set for the course, turn the compass until the lubber line is over the N point of the swinging dial).

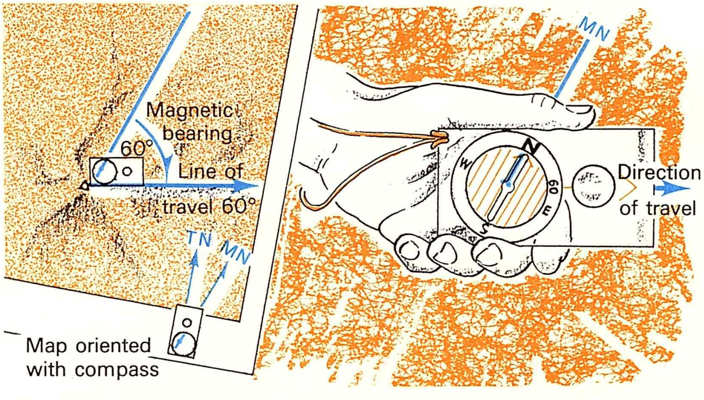
The sighting line now points in the desired direction.



Following a course – Swinging dial compass

(c) USING AN ADJUSTABLE DIAL COMPASS

1. Orient the map, using the compass.
2. Place the compass on the map with the edge of the base plate along the next stage of the route and the direction-of-travel arrow pointing towards the destination.
3. Rotate the adjustable dial until the N point is at the needle point.
4. The magnetic bearing of the destination is indicated on the dial at the direction-of-travel arrow, but the bearing need not be memorised provided the dial is not subsequently rotated.
5. To check the course during travel, hold the compass steady, then turn the whole compass until the N point on the dial is at the needle point. The direction-of-travel arrow now points in the desired direction.



Following a course – Adjustable dial compass

TAKING A BEARING ON THE OBJECTIVE

If a temporary sighting is made of the next objective, perhaps from a high point or a break in the bush or cloud, the opportunity should be taken to set a magnetic bearing without having to use the map. Of course, identification of the objective must be definite.

(a) USING A NON-ADJUSTABLE COMPASS

1. Hold the compass steady at eye level, and turn around until the N point on the base lies under the needle point.
2. Sight across the compass, through its centre, towards the objective and read the magnetic bearing on the objective side of the compass.
3. Memorise the magnetic bearing.

(b) USING A SWINGING DIAL COMPASS

1. Hold the compass steady at eye level, and align the sighting line on to the objective.
2. Read the magnetic bearing from the swinging dial either:
   (a) at the sighting line.
   or (b) for a prismatic compass, through the prism.
3. Memorise the magnetic bearing or, to save memorising, rotate the adjustable lubber line until it is over the N point of the dial while the sighting line is aligned on the bearing.

(c) USING AN ADJUSTABLE DIAL COMPASS

1. Hold the compass steady at chest level, and align the direction-of-travel arrow on to the objective.
2. Rotate the adjustable dial so that the N point is at the needle point.
3. The magnetic bearing is indicated on the dial at the direction-of-travel arrow, but the bearing need not be memorised provided the dial is not subsequently rotated.

CHECKING THE COURSE

During travel, when the objective is not in sight, frequent pauses may be required to check that the direction is generally being followed.

Use the method of checking described on p. 22, section (a) 5.; p. 23, section (b) 5.; or p. 24, section (c) 5. according to the type of compass used.

ADVANCED USES OF MAP & COMPASS

If an accurate type of compass and a protractor (or combination compass-protractor) are used in conjunction with a map, more precise methods may be employed for setting a course, for identifying a feature or for finding one's position.

The following descriptions are given in terms of the adjustable dial type of compass-protractor as illustrated at the bottom of page 17.

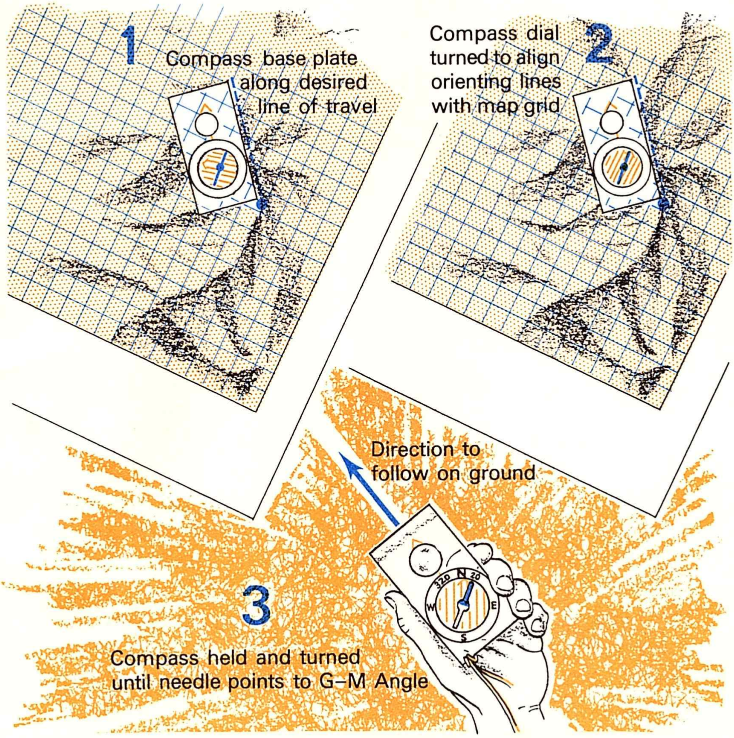
It is left to the owner of a semi-prismatic compass to develop corresponding procedures using a swinging dial compass and protractor.

It should be noted that this section describes the referencing of bearings from *Grid* North and *not Magnetic* North.

SETTING A COURSE

Note: The map need not be oriented for this method.

1. Place the compass on the map with the edge of the base plate along the next stage of the route, and the direction-of-travel arrow pointing towards the destination.
2. Rotate the adjustable dial until the orienting lines are parallel to the north-south grid lines on the map, with the orienting arrow pointing to the top (north) of the map. The reading on the dial at the direction-of-travel arrow represents the grid bearing of the destination, but this bearing need not be memorised provided the dial is not subsequently rotated.
3. Put the map aside. Hold the compass steady and turn around until the compass needle points to the G-M angle as stated in the map border. (Use 20° mark if in doubt). The direction-of-travel arrow now points in the required direction.



Setting a course – Adjustable dial compass (map not oriented)

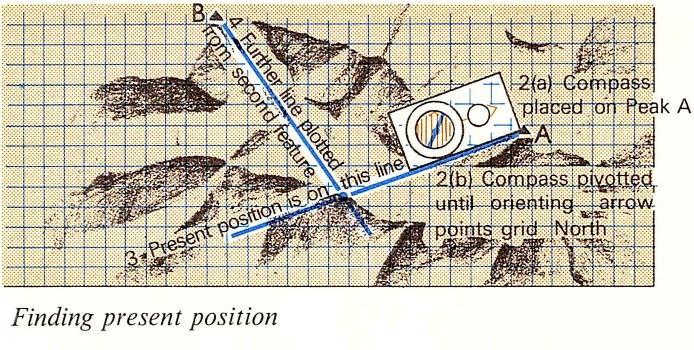
IDENTIFYING A DISTANT FEATURE

1. Take a grid bearing.
   (a) Hold the compass at chest level and align the direction-of-travel arrow on the unknown feature.
   (b) Rotate the adjustable dial until the compass needle points to the G-M angle on the dial (approx 20°)
2. Plot the grid bearing on the map.
   (a) Place the compass on the map with the edge of the base plate on present position.
   (b) Pivot the whole compass around (keeping the edge of the base plate on present position) until the orienting arrow on the adjustable dial is parallel to the North-South grid lines on the map and is pointing northwards.
   (c) It should now be possible to identify the unknown feature as it will lie somewhere along the line of the edge of the compass base plate.

FINDING PRESENT POSITION

If surrounding features can be identified on the ground and the map the following method may be used to find the present position of the observer.

1. Select a feature (A) and take a grid bearing on it.
2. Plot the grid bearing on the map.
   (a) Place the compass on the map with the edge of the base plate on the feature.
   (b) Pivot the whole compass around (keeping the edge of the base plate on the feature) until the orienting arrow on the adjustable dial is parallel to the North-South grid lines on the map and is pointing northwards.
3. The present position lies somewhere along the edge of the base plate which passes through the feature. If on a known ridge or river, or other long, narrow feature, the present position will be where it is intersected by the edge of the base plate.
4. However, if present position is not on any recognisable feature it will be necessary to take a grid bearing on a second feature (B) and, using the same steps as above, pencil lines on the map along the edge of the compass until they cross.



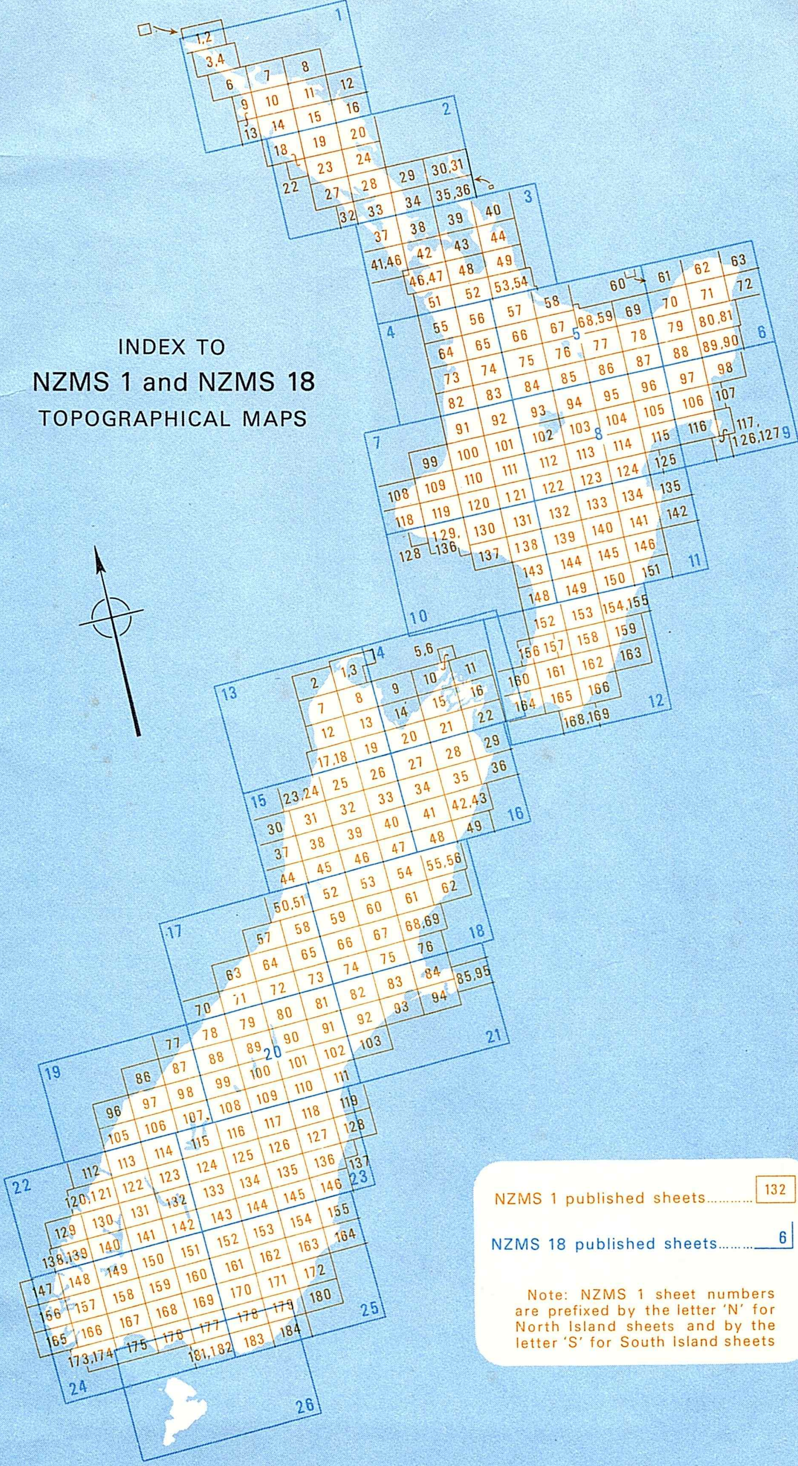
Finding present position

Greatest accuracy will be achieved by application of the following:—

1. Use a third bearing if another feature is recognisable. The present position should lie within a small triangle formed by the three plotted bearings.
2. If taking a single bearing only, choose a feature as near as possible to 90° from the line of ridge or river.
3. If taking two bearings select features as near as possible to an angle of 90° apart.

A. R. SHEARER, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1976

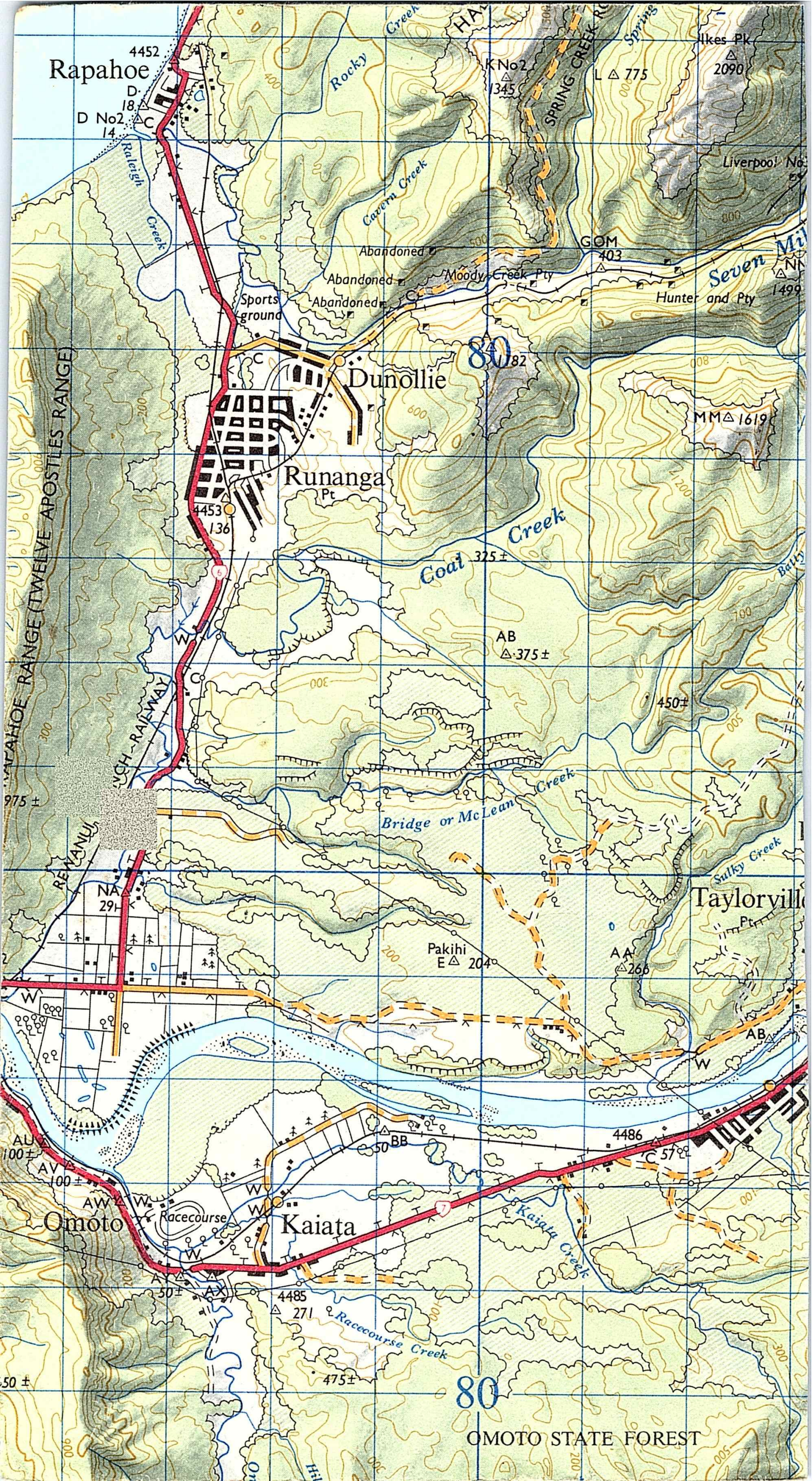
INDEX TO
NZMS 1 and NZMS 18
TOPOGRAPHICAL MAPS



NZMS 1 published sheets............ 132

NZMS 18 published sheets........... 6

Note: NZMS 1 sheet numbers are prefixed by the letter 'N' for North Island sheets and by the letter 'S' for South Island sheets


Rapahoe
Dunollie
Runanga
Kaiata
Omoto
Taylorville
Racecourse
Sports ground
Coal Creek
Rocky Creek
Cavern Creek
Raleigh Creek
Bridge or McLean Creek
Sulky Creek
Kaiata Creek
Racecourse Creek
Seven Mile
Moody Creek Pty
Hunter and Pty
Abandoned
Abandoned
Abandoned
SPRING CREEK
RAPAHOE RANGE (TWELVE APOSTLES RANGE)
REWANUI BRANCH RAILWAY
Pakihi
OMOTO STATE FOREST
80
80